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Thermo-mechanical analysis of functionally graded plate-like nanorotors: A surface elasticity model

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Abstract

Nanorotors could have many applications in nanotechnology, however, their thermo-elastostatic responses due to rotary motion as well as externally applied loads have not been examined yet. This paper deals with thermo-elastic fields of rotating functionally graded nanoscale plate-like rotors using the surface elasticity theory of Gurtin and Murdoch. By dividing the nanoplate into adequate number of annular rings, the analytical expressions of elastic fields within these rings are appropriately derived. Due to the symmetry of both thermal loading and the exerted centrifugal force, the elastic field is symmetric and each ring has only two unknown parameters. To determine these parameters, appropriate boundary conditions at the interfaces of the rings as well as the non-classical conditions at the innermost and outermost surfaces of the nanoplate are defined and enforced. In a particular case, the obtained results are checked with those of another work and a good agreement is achieved. The roles of the environment's temperature, angular velocity, power-law index, and surface energy effect on the resulted thermo-elastic fields are carefully studied. This work can be regarded as a crucial step in nanomechanical assessing of advanced composite nanorotors.

Keywords: Nanorotor; Rotating annular nanoplate; Functionally graded materials; Thermo-mechanical analysis; Surface effect.

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